

Installation and setup guide

Mac OS X™ 10.5 Leopard for unsupported PowerPC™ computers



© Tim M. 2010

Only to be redistributed in original unmodified form.
Not for resale.



Mac



Universal

Mac OS X™ Leopard for unsupported PowerPC™ computers: Installation and Setup Guide

First published 2010

Edition 1.0.4

© Tim M. 2010

Only to be redistributed in original unmodified form. Not for resale.

With many thanks to James Little, who originally worked out what kernel extensions pre-AGP Macs require adding to Leopard for it to run, as well as how to disable the “Beige” Power Mac G3’s integrated graphics controller to ensure stable running of these systems.

Apple, Mac, Power Macintosh, iMac, iBook, eMac, PowerBook, Mac OS, Mac OS X, the “Mac” logo and the “Universal” logo are registered trademarks of Apple Inc.

ATI, Radeon and Rage Pro are registered trademarks of AMD Inc.

NVIDIA and GeForce are registered trademarks of NVIDIA Corporation.

PowerPC and Velocity Engine are registered trademarks of IBM Corporation/Freescale Semiconductor Inc.

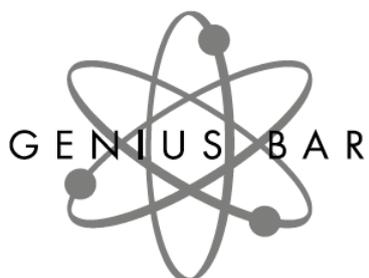
VMware Workstation is a registered trademark of VMware Inc.

Windows is a registered trademark of Microsoft Corporation.

All other trademarks used herein are the property of their respective owners. All images/icons used are the property of their respective owners.

CONTENTS

1. INTRODUCTION
2. MAC OS X 10.5 LEOPARD FOR SUB-867 MHz POWER MACINTOSH G4 COMPUTERS WITH BUILT-IN AGP GRAPHICS
3. MAC OS X 10.5 LEOPARD FOR POWER MACINTOSH COMPUTERS WITHOUT AGP GRAPHICS
4. OPTIMISATION OF MAC OS X 10.5 LEOPARD AFTER INSTALLATION



1. INTRODUCTION

With the release of Apple's Mac OS X 10.5 Leopard operating system in October 2007, the company sought to prevent the installation and use of the latest version of the Macintosh operating system on a wide range of older Mac computers.

The previous version of Mac OS X, 10.4 Tiger, had been officially supported on Macs dating back to those with G3 processors and built-in FireWire ports, the earliest of these including the 1999 iMac G3 DV (slot-loading), "Blue and White" Power Mac G3, and iBook G3 SE. It had also been relatively straightforward to install Tiger on older Macs that had been desupported either with the introduction of the requirement of built-in USB ports (NewWorld ROM architecture) with Panther (version 10.3), or the FireWire requirement of Tiger. These models include the "Beige" Power Mac G3, older PowerBook G3 laptops, as well as the original iMac and iBook G3 models that lacked integrated FireWire ports.



In contrast, the official minimum requirement for Leopard was set at a steep 867 MHz PowerPC G4 processor or faster: this meant that not only were all Macs with a G3 processor not supported (including the iBook G3s with processor speeds up to 900 Mhz, still sold up until October 2003), a large proportion of the G4s were also officially to run a maximum of Mac OS X Tiger. These included many iMac G4s, Power Mac G4s (including high-end dual-processor 800 Mhz models with greater performance than a single 867 Mhz model), and PowerBook G4s.



However, there is certainly no need to remain with Tiger on the majority of these Macs, as in many cases Apple's system requirements can be circumvented and once a successful installation has been completed, Leopard will usually run just as well as, if not better than, Tiger while also providing the far more modern user interface, features and application compatibility that comes with Mac OS X Leopard.

Unfortunately Apple chose to compile Leopard without PowerPC G3 support, meaning that it is impossible for it to be run on any computer with a G3 processor. While the Power Mac G3 ("Beige" and "Blue and White") as well as some even older pre-G3 models can be upgraded to a G4 processor with fairly common replacement processors such as those produced by Sonnet, and the PowerBook G3 can be upgraded with a much rarer part, the soldered-in processor of the iMac and iBook G3 means that they are unable to run Leopard. It is however very straightforward to install

and run Leopard on Macs with G4 processors and built-in AGP graphics, and possible but a much more involved process on Macs with G4 processors (either factory-installed or upgraded from G3) but no AGP slot. This guide outlines the process for both types of installation and is applicable to both Leopard client and Leopard Server.



2. MAC OS X 10.5 LEOPARD FOR SUB-867 MHz POWER MACINTOSH G4 COMPUTERS WITH BUILT-IN AGP GRAPHICS

This section covers the installation of Leopard on Macs that have a G4 processor and also AGP graphics (in the form of integrated graphics circuitry or an AGP slot on the motherboard). This encompasses the following computers (sub-867 Mhz G4 versions only):



iMac G4



Power Mac G4 "Graphite"
(AGP graphics versions)



Power Mac G4 "Quicksilver"



PowerBook G3 "Pismo"
(upgraded to G4 CPU)



PowerBook G4 "Titanium"



eMac G4

Note that for an optimum experience with Leopard the Mac should be upgraded to have at least 512 MB of memory, a hard disk of 10 GB or larger, and a Radeon or GeForce graphics card (as opposed to the ATI Rage Pro cards that some earlier models originally shipped with). However, the operating system will function with lower specifications than these. A DVD drive is required as Tiger was the last version of Mac OS to be available on CDs.

Also ensure that the latest firmware version available from Apple for the model of Mac in use is installed before beginning.

The only problem that needs to be circumvented on these computers is the fact that Apple inserted a piece of script in the *Distribution* script that is inside the Leopard installation metapackage (*OSinstall.mpkg*) which checks for a processor speed of 867 MHz or greater when the machine is started up from the DVD. If the CPU speed is found to be lower than this, the installation is cancelled with a message claiming that the computer is "not compatible" with Leopard. As demonstrated by the results when this line of script is removed or circumvented, this is no more than a lie to encourage users of older Macs to purchase a new model for "compatibility" with the newer operating system.



Probably the simplest way to work around the problem is the method whereby a script is run in the Mac's Open Firmware interface (the PowerPC Mac equivalent of a PC's BIOS) to update the device tree and cause the machine to report its processor speed as being 867 MHz until it is next restarted.

This is done as follows:

- Hold the Command, Option, O and F keys together when starting the machine and only release them once the Open Firmware command line has appeared.
- Insert the Leopard DVD into the Mac's DVD drive.
- Run the following script exactly as below (including capitals), press *Enter* after each line and check that Open Firmware displays "ok":

For single-CPU Macs:

```
dev /cpus/PowerPC,G4@0
d# 867000000 encode-int " clock-frequency" property
boot cd:,\\:tbxi
```

For dual-CPU Macs:

```
dev /cpus/PowerPC,G4@0
d# 867000000 encode-int " clock-frequency" property
dev /cpus/PowerPC,G4@1
d# 867000000 encode-int " clock-frequency" property
boot cd:,\\:tbxi
```

The Mac will then start up from the Leopard DVD and installation can proceed as normal. The modified CPU speed should only be in effect until the next reboot; however if it persists or problems are encountered the machine's *PRAM* (parameter RAM) can be reset by holding down the Command + Option + P + R keys before hearing the boot chime and only releasing them when the boot chime sounds again.



It is also possible to modify the Leopard installation DVD so that the CPU speed is not checked, resulting in a new DVD which can be used on any Mac with a G4 processor and AGP graphics to install Leopard with no more difficulty or steps than on an officially supported machine. This may well be worth doing if installing Leopard on several Macs.

To do this (this will require another PC, Mac or virtual machine that is already running Mac OS X 10.5 Leopard or later) follow these steps; alternatively download a pre-modified *OSinstall.mpkg* file if you do not have access to another computer with Leopard already installed:

- Use the free software *Carbon Copy Cloner* to make an image of the Leopard DVD, choosing to back up the drive to a *read/write sparseimage*. It is worth ejecting the DVD once complete to avoid confusion.

- Mount the newly-created image and navigate to `/System/Installation/Packages/`. Note that to view these folders on the DVD, hidden files must be made visible in OS X – this can be done using a utility such as *TinkerTool* or *OnyX* or by running the following scripts in Terminal:

```
defaults write com.apple.finder AppleShowAllFiles TRUE
killall Finder
```

(replace TRUE with FALSE afterwards to revert to the default setting of hidden files being invisible)

- Drag the *OSInstall.mpkg* file (this is the metapackage that is opened when the DVD is first booted and the Installer appears) on to the Desktop, open Terminal and run the following commands (assuming that the Home directory is the current working directory, which it should be in a newly-opened Terminal):

```
cd desktop/package
```

(changes working directory)

```
xar -x -v -f ~/Desktop/OSInstall.mpkg
```

(extracts the contents of *OSInstall.mpkg* to a newly-created folder named *package*)

- Navigate to the newly-created *package* folder and open the file named *Distribution* in TextEdit. The important piece of script is shown below and it is recommended that the three parts in **bold** are amended. The script works by returning a Boolean value of *true* except when certain conditions are met, for instance if the CPU speed is found to be less than 867 MHz, a value of *false* is instead returned. By changing this *false* to *true* in the script, a value of *true* will always be returned regardless of the CPU speed.

The memory requirement at the top can also be reduced to make a DVD that will install to a Mac with less than 512 MB of memory – Leopard will run with just 256 MB or possibly even less, but 512 MB or more is recommended for good performance.

```
minRam = 512;

function checkSupportedMachine (machineType) {
    // Fail on G3
    if (1 != system.sysctl('hw.vectorunit') ) {
        return false;
    }

    var badMachines =
['MacBook3,1', 'iMac', 'PowerBook1,1', 'PowerBook2,1', 'AAPL,Gossamer',
'AAPL,PowerMac G3', 'AAPL,PowerBook1998', 'AAPL,PowerBook1999'];

    if (machineType) {
        var length = badMachines.length;

        // Fail if any of the compatible values match the
list of badMachines
        for( var j = 0; j < length; j++ ){
            if (machineType == badMachines[j]){
                return false;
            }
        }
    }
}
```

```

        }

    }

    // require 867Mhz+
    if (system.sysctl("hw.cpufrequency") < 866000000) {
        return false;
    }

    return true;
}

```

There is little point changing the part that checks for a G4 processor as Leopard was compiled without G3 binary support anyway so will not run regardless. You will notice that certain older Macs are excluded using their model identifiers so it is worth making this section also always return *true*, while newer machines are excluded only on the basis of CPU speed.

- Once completed, save the changes made and quit TextEdit. Then delete the original *OSinstall.mpkg* from the Desktop and run the following command in Terminal to compile the files in the *package* folder back into a new metapackage:

```
xar -c ./ -v -f ~/Desktop/OSInstall.mpkg
```

The *package* folder can then be deleted also.

- In the disk image that should still be mounted on the Desktop, now replace the original *OSinstall.mpkg* with the new version. The disk image is now ready to burn to a blank DVD, however the original Leopard DVD is a dual-layer disc of around 6.5 GB so it is worth reducing it to single-layer (less than 4.5 GB) size so that it can be burned to an ordinary single-layer disc.

To do this, simply delete the *Xcode Tools* package from the *Optional Installs* folder on the root of the image, as well as the packages in */System/Installation/Packages* for all of the printer drivers and all of the foreign languages packs (do not delete *AsianLanguageSupport.pkg* though, this is not a language pack and will cause the installation to fail if it is not present). Be sure to empty the Trash (Finder > Empty Trash) after deleting these files. Finally, create a new 4.7 GB (SL-DVD) *sparseimage* in Carbon Copy Cloner or Disk Utility, restore the edited image to this new one, and burn to a blank DVD once ready.

Note that if this is done, you will need to select *Customise* when installing Leopard and deselect the additional language packs and printer drivers otherwise it will result in an error when it cannot find the deleted packages – this should be done anyway though otherwise several gigabytes will be wasted by files unneeded by the majority of users.



Regardless of which method is followed, the installation of Leopard should proceed normally, starting up from the DVD (holding the C key to boot from the optical drive if an operating system is already installed on the hard drive), formatting the target partition, selecting *Customise* in the Installer to deselect unnecessary components, and beginning the installation (note that selecting *Skip* when it begins to validate the installation DVD will save time).

After installation, the 10.5.8 "Combo" updater should be downloaded from the Apple website to update Leopard to its latest release regardless of the version that was on the original DVD. Running the built-in Software Update utility will download remaining updates after 10.5.8 is installed.

Once complete, proceed to the *Optimisation of Mac OS X 10.5 Leopard* section.



Troubleshooting:

- *A kernel panic (message stating "You must restart your computer" in several languages is displayed) is experienced when starting up from the Leopard DVD:* ensure that the Mac's PRAM battery is working. This can be tested for by turning off Network Time Synchronisation in an existing installation of Mac OS 9 or X on the machine, setting the correct time on the machine, shutting down and unplugging it to let any volatile memory clear, then plugging it back in and starting it up again. If the date/time has reverted to a default value, the battery needs to be replaced. Some Macs will not start up from the Leopard DVD correctly with a dead PRAM battery.
- *Very poor performance is experienced on a Mac with an ATI Rage Pro graphics card:* for best results it is recommended that a Radeon or GeForce card is used. However, the Rage Pro will perform worse by default in Leopard than in previous versions of OS X because Apple did not supply a driver for it with Leopard, given that no Macs that were originally shipped with this graphics card are officially supported. To improve its performance somewhat, the kernel extensions (*kexts*) from Tiger can be copied into Leopard's `/System/Library/Extensions` folder once it is installed.

These files are named *ATIRage128.kext*, *ATIRage128DVDDriver.bundle*, *ATIRage128GA.plugin*, *ATIRage128GLDriver.bundle*, *ATIRagePro.kext*, and *ATIRageProGA.plugin* and once in the Extensions folder they need to have the correct file permissions applied to them for them to be recognised and loaded at the next reboot of the system. To do this, run the following commands in Terminal and then restart the computer:

```
sudo -s  
chown -R root:wheel /System/Library/Extensions/ATIRage*.*  
rm -rf /System/Library/Extensions.mkext
```



3. MAC OS X 10.5 LEOPARD FOR POWER MACINTOSH COMPUTERS WITHOUT AGP GRAPHICS

This section covers the installation of Leopard on older Macs that do not have built-in AGP graphics circuitry nor an AGP slot on their motherboard, including models that were not officially supported even for Tiger or in some cases, any version of Mac OS X at all. This encompasses the following computers:



Power Mac G3 "Beige" and pre-G3 "beige" Macs supported by XPostFacto



Power Mac G3 "Blue and White"



Power Mac G4 "Yikes" (PCI graphics version only)



PowerBook G3 (not including "Pismo")

As these Macs are older and much further away from the machines that Leopard was designed and tested for, this process is more complicated and requires the installation to be carried out on a second machine (PC, Mac or virtual machine already running Leopard or later) and the completed installation to be transferred to the target Mac, as it is not possible to boot from the Leopard DVD and complete the installation as normal. The Leopard installation package format (XAR) is not compatible with older versions of Mac OS X, so it is not possible to run the installation from an already-installed copy of an older version of OS X on the target machine either.



The same recommendations/requirements apply as for later Macs i.e. 512 MB of RAM or more is required for good performance although Leopard will run with less, a Radeon or GeForce graphics card is recommended and is required for the Power Mac G3 "Beige" as the integrated graphics that it has is not compatible with Leopard (although working to some extent it causes freezes and needs to be disabled for reliable functioning), and at least 10 GB of hard drive space is recommended. **A G4 processor is required in all instances** – for the "Beige" and "Blue and White" Power Macs, the Sonnet Encore G4 500 MHz or 1.0 GHz processor upgrades are relatively common and are easy to install with no jumper configuration needed

For NewWorld ROM architecture Macs (identified by them having built-in USB ports), ensure that the latest firmware update from Apple for the particular model of Mac has been installed before beginning. OldWorld architecture machines ("Beige" G3 and previous Power Macs and PowerBooks that do not have built-in USB ports) do not have updateable firmware, but will need a working operating system already installed on a separate partition of their hard drive from which to run the XPostFacto utility later on in the installation process, it is recommended that Mac OS 9 is installed and updated (9.2.2 is the latest version of the Classic Mac OS and is supported on G3 and later Macs; pre-G3 machines can be updated to 9.1 and most can unofficially run 9.2.2 using the free *OS9 Helper* utility, although 9.2.2 is not required for the installation of Leopard).

If installing to a “Beige” Power Mac G3, at least one partition must exist on the hard drive that is at the beginning of the disk and is less than 8 GB in size (this does not have to be the partition that Leopard is installed to though – see *Page 16* for more information on the “8 GB limit”).

As with newer Macs, it is recommended that a working PRAM battery is fitted as a dead battery can result in problems and weird behaviour of the machine.



Once ready, follow these steps to install Leopard:

1. Connect the hard drive from your Mac to another computer that is already running Leopard or later (this can be a PC “Hackintosh” or a PowerPC/Intel Mac, or a virtual machine running Leopard installed on a Windows-only PC). Ideally it will already be set up with a partition with Mac OS 9 installed (if required) and the rest of the drive partitioned for Leopard, with both partitions formatted with Apple’s HFS+ filesystem. The drive must be formatted under Mac OS 9 if the partitions are to be usable with OS 9 as well as OS X.

Note that if you have OS X installed in VMware Workstation on a PC, a physical hard drive can be added to the virtual machine by going to VM > Settings, then selecting Add... > Hard Disk > Use a Physical Disk, then select the drive and “Use entire disk”.

- ✓ If using a PowerPC G4 Mac with a processor speed of less than 867 MHz, the installation disc must first be modified or the Open Firmware script to fake a CPU speed of 867 MHz must be run to allow the installation to proceed, as described in *Section 2: Mac OS X 10.5 Leopard for sub-867 Mhz Power Macintosh G4 Computers with built-in AGP Graphics*.
- ✓ If using an Intel PC or Mac running OS X, the installation disc may need to be modified to allow installation to the hard drive that has been formatted for the PowerPC Mac – read step 4 of this section completely before beginning the installation.

2. Start up your existing installation of OS X; the partition that Leopard will be installed to should be visible in the Finder (if already formatted from Mac OS 9 as recommended).
3. Insert the original Leopard DVD and make hidden files visible by running the following command in Terminal (these makes the installation packages on the disc that are hidden by default visible):

```
defaults write com.apple.finder AppleShowAllFiles TRUE  
killall Finder
```

(run the same commands again but replace *TRUE* with *FALSE* to revert to the default)

4. Navigate to `/System/Installation/Packages/` on the Leopard DVD and double-click the *OSinstall.mpkg* file. This will start the Installer for Leopard, which normally starts when starting up a Mac from the DVD. If using a newer PowerPC Mac to perform the installation

directly to the hard drive that was taken from the target Mac, this part of the installation can be completed as normal, ensuring that the correct partition is selected when prompted for a destination. Be sure to click *Customise* when it is available near the beginning of the installation to deselect unneeded components such as language packs and printer drivers that will otherwise occupy a significant amount of disk space. After this is complete, proceed straight to step 5.

If however a computer with an Intel processor is being used, the Installer will say that the partition(s) on the hard drive are not a valid installation destination because they are formatted with Apple Partition Map (APM) rather than GUID Partition Table. The Installer will by default only allow installation to GUID-formatted drives on an Intel Mac as these are the only drives that an Intel Mac can boot from, while PowerPC Macs can only boot from APM drives; however Apple did not plan for the scenario where the OS is being installed on an Intel machine but for a PowerPC!

In this situation there are two options. If using a virtual machine a new virtual hard drive can be added to the virtual machine, formatted with the GUID partition table in OS X's Disk Utility, OS X installed to this partition, and the resulting installation cloned to the hard drive that was taken from the target Mac using *Carbon Copy Cloner*.

This is most likely the more straightforward option, however the other option is to edit the *OSinstall.mpkg* metapackage so that it will install to APM or GUID drives regardless of the type of machine that it is run on. This will be the easier option if using a physical Intel PC/Mac to complete the installation rather than a VMware virtual machine; also the file can be retained so that any subsequent installations are quicker.

To do this, a similar method to that which removes the 867 MHz check that is described in *Section 2: Mac OS X 10.5 Leopard for sub-867 Mhz Power Macintosh G4 Computers with built-in AGP Graphics* is used to edit the *Distribution* file that is inside the *OSinstall.mpkg* metapackage. Follow the bullet point steps in that section exactly the same, except instead of/as well as making the edits to circumvent the system requirement checks, also remove the following line from the script (it is found near the beginning of the file):

```
eraseOptionAvailable='true'
```

Then continue with those steps, making a new *OSinstall.mpkg* and putting it back into a writeable image of the Leopard installation DVD.

Once the installation from *OSinstall.mpkg* is complete, the target partition should contain a brand new installation of Leopard at whichever version (10.5.x) the DVD that was used contained.

5. The installation then needs to be updated to the latest release of Mac OS X (10.5.8) and have a number of additional files added to it for compatibility with pre-AGP Macs before the drive is put back into the target Mac.

The 10.5.8 "Combo" updater should be downloaded from the Apple website and can be applied to the new installation either by double-clicking the package as normal and selecting the correct partition as the destination when prompted, or by using the package extraction software *Pacifist* to install the package manually. It is recommended that the former approach is used, unless a version of OS X newer than 10.5 Leopard is being used to

complete the installation as the 10.5.8 package will refuse to install through Apple's Installer utility if the version of the running operating system is not 10.5.x. If a small disk partition is being used (not recommended) and the update cannot be installed due to insufficient space, disk space can first be recovered using the methods outlined in *Section 4: Optimisation of Mac OS X 10.5 Leopard after installation*.

6. Once this is done, some files from version 10.5.5 need to replace the 10.5.8 versions installed by the "Combo" updater as 10.5.5 seems to be the latest version that does not introduce further incompatibilities with pre-AGP Macs.

The following files from 10.5.5 were found to be needed for a successful 10.5.8 installation on a G4-upgraded "Beige" Power Mac G3. No adverse effects have been noted as a result of using the older kernel version so it is recommended to replace these files for all installations, although it has not been tested whether it is required for newer pre-AGP Macs:

- ✓ */mach_kernel*
- ✓ */System/Library/Extensions/System.kext*
- ✓ */System/Library/Extensions/Seatbelt.kext*
- ✓ */System/Library/Extensions/IONDRVSupport.kext*

The first three files must all be replaced together to avoid problems if a different kernel version (the *mach_kernel* file) is used.

After replacing any OS X system file it is essential that the correct file permissions are applied to the files, otherwise they may not be usable during the boot process. This will be covered in *Step 8* (below) after the addition of further kernel extensions required for the installation in *Step 7*.

7. The following files must then be added to the installation to add support for the hardware found in the pre-AGP Macs – these kernel extensions were taken from pre-release builds of Leopard and from Mac OS X Tiger 10.4.11 as support for this hardware was provided in those versions but removed from Leopard's final release. They must be placed in the */System/Library/Extensions/* folder unless otherwise stated and the first group below should be installed for all pre-AGP Macs:

- ✓ *AppleCuda.kext*
- ✓ *AppleGossamerPE.kext*
- ✓ *AppleGracklePCI.kext*
- ✓ *AppleHeathrow.kext*
- ✓ *CMD646ATA.kext*
- ✓ *HeathrowATA.kext*
- ✓ *IOGraphicsFamily.kext* (replace Leopard version)
- ✓ *SonnetCache.kext* (enables Level 2 Cache if using a Sonnet processor upgrade)

- ✓ *IOFireWireFamily.kext* (for "Blue and White" G3 and "Yikes" G4 only, replace Leopard version)
- ✓ *IONetworkingFamily.kext* (for "Blue and White" G3 and "Yikes" G4 only, replace Leopard version)

- ✓ *AppleBMacEthernet.kext* (for “Beige” G3 only, required to enable built-in Ethernet port – this needs to be placed in `/System/Library/Extensions/IONetworkingFamily.kext/Contents/Plugins/` – right click *IONetworkingFamily.kext* and select *Show package contents* to open it)

8. Once all of the files have been added, the correct file permissions must be applied to all of them for them to be recognised in the boot process. If when booting from the new installation an error of the form “Unable to find driver for platform...” is displayed and the files have been added, the permissions are most likely incorrect. The built in *Repair Permissions* tool in OS X’s Disk Utility will not apply all of the permissions needed as it only applies to files that were included in the original installation packages, not additional files added later.

The easiest way of applying the file permissions is to use the free software *BatChmod*, a graphical interface to OS X’s UNIX file permissions:



The correct permissions are as follows and must be applied to each file that has been added/replaced in turn by dragging it to the *File* box in *BatChmod*, ensuring that the correct permissions are set and *Apply to enclosed files and folders* is ticked (as in the above screenshot):

- ✓ Each *.kext* file added to the Extensions folder: *Owner* root (read **R**, write **W** and execute **X**), *Group* Wheel (read and execute), *Everyone* (read and execute) (these permissions are shown in the above screenshot).
- ✓ Kernel (*mach_kernel*, hidden files will need to be set as visible for it to be possible to drag the file to *BatChmod*): *Owner* root (read and execute), *Group* Wheel (read), *Everyone* (read).

Be sure to apply the correct permissions to every file that was replaced/added. Note that when dragging a file to *BatChmod* again to check that the correct permissions have been applied they will sometimes not show up and instead the currently logged-in user will show as the *Owner* and the *Group* as *Staff*, this appears to be in situations such as when installing Leopard to a disk image as opposed to a physical disk. As long as the permissions have been applied to each and every file in turn, it should not be a problem (they will be displayed correctly when booted from the new installation of Leopard).

9. Delete the following files if they exist:

- ✓ Entire contents of folder `/System/Library/Caches/`
- ✓ Entire contents of folder `/System/Library/Extensions/Caches/`
- ✓ File `/System/Library/Extensions.mkext`

10. Shut down the computer and move the drive containing the new installation back to the target Mac. Start up the machine – if a NewWorld Mac (identified by built-in USB ports) then the process should be complete and the Leopard Setup Assistant will appear after a long first boot where the boot caches are created (if operating system(s) were already present on other partitions or drives, it will be necessary to select the new Leopard installation in the OS 9/OS X *Startup Disk* control panel and reboot.

If an OldWorld ROM architecture Mac however (no built-in USB ports ie the “Beige” G3 or earlier), the free *XPostFacto* utility must first be used to add further kernel extensions for hardware support (*Step 7* above added back extensions that had been removed between Tiger and Leopard as Macs such as the “Blue and White” G3 were officially supported in Tiger – *XPostFacto* includes extensions that were removed from Mac OS X 10.3 Panther onwards, as OS X 10.2 Jaguar was the last version to contain official support for OldWorld Macs such as the “Beige” G3) and enable OS X boot support for the OldWorld architecture.

Therefore select Mac OS 9 (if installed previously) as the startup disk by holding the *Option* key on an ADB keyboard (USB keyboards cannot be used for entering startup commands on Macs without built-in USB as their USB is not initialised until the operating system has started loading) until the OS 9 boot screen appears.

Open *XPostFacto* and select the partition from the list that contains the new Leopard installation.

⚠ Important: the “Beige” Power Mac G3 and some other older Macs that use ATA drives (such as tray-loading iMac G3 models) can only normally boot OS X if it is installed on a partition that is the first partition on the disk and is less than 8 GB in size (this restriction does not apply to Mac OS 9). If the Leopard partition does not meet these requirements (and it is recommended that it is larger than 8 GB for best results), a partition that does meet these requirements **must** be selected as the *Helper* volume in *XPostFacto* (with the partition containing Leopard selected, choose the *Helper* volume from the drop-down menu found to the right of the partition list. This causes the kernel (*mach_kernel*) and *Extensions* folder to be copied to the *Helper* volume, from where the boot process is initiated – if the *Extensions* folder is later updated at any point, *XPostFacto* will display a notification and it will be necessary to re-synchronise the *Helper* volume with the main partition.

Once the *Helper* volume has been set (if necessary) and the Leopard partition is selected, click “Restart”: after confirming, the additional kernel extensions and OldWorld boot support will be copied to the target partition and the *Helper* volume (if enabled) will be synchronised before the Mac restarts in Leopard.



Once everything is complete Leopard should hopefully be running by this point – if so, proceed to *Section 4: Optimisation of Mac OS X 10.5 Leopard after installation* (this applies to all Macs but more so older models with limited system resources).

⚠ Important: sudden freezing of the system after less than an hour of running has been noted on Power Mac G3 “Beige” computers with G4 processor upgrades and Mac OS X installed. This appears to be due to incompatibilities between their built-in ATI Rage graphics controller and Mac OS X (a dedicated graphics card should always be used with the “Beige” G3 as the built-in video is largely incompatible with most versions of OS X).

Running the following command at the Open Firmware command prompt (accessed by holding the Command, Option, O and F keys together when starting the machine and only releasing them once the Open Firmware command line has appeared) will disable the built-in graphics altogether but will only be in effect until the machine is next shut down, after that it will return to the default:

```
setenv pci-probe-list fffbffff
```

The command must be run using an ADB keyboard; after typing it in press the *Enter* key followed by the Ctrl + Command + Power combination to reset the machine and load Mac OS X. Note that to see the Open Firmware screen the default boot output device in XPostFacto must have already been set to the graphics card that is in use, as the default device is the built-in graphics and so nothing will be seen if no display is connected to it. The setting of the output device will have already happened if the OS X partition has been set as the default boot partition and the PRAM has not been reset since using the Command + Option + P + R startup combination. If not, the commands can be carefully entered without any display, or the built-in video port can be used.

If freezing is experienced on a “Beige” G3 or older, try using this command and running the computer for several hours afterwards. It is not applicable to newer Macs that do not have built-in graphics controllers. If this does resolve problems the following script can be run in Open Firmware to set it so that it is retained between restarts (press the Enter key every time [Enter] appears):

```
nvedit [Enter]
setenv pci-probe-list fffbffff [before typing in this line use the arrow
keys/backspace to delete the “hex” text that appears after entering the previous command]
[Enter]
[press Ctrl + C keys together, the normal Open Firmware command line should reappear]
nvstore [Enter]
setenv use-nvramrc? true [Enter]
reset-all [Enter]
```

These commands respectively enter the hexadecimal NVRAM (non-volatile RAM/PRAM) editing mode, tell the PCI prober to ignore the built-in graphics controller, change back to the normal input mode for entering Open Firmware commands, store the changes made to the NVRAM, tell the firmware to use the NVRAM patches (including the one that has just been created), and finally restart the Mac with the new settings in effect.

Resetting the PRAM (NVRAM) using the Command + Option + P + R startup combination will remove the effects of the above commands and re-enable the built-in graphics, as will unplugging the Mac from the power if there is not a working PRAM battery installed (it is highly recommended that a working battery is obtained regardless though as weird behaviour is often experienced without one). It has also been known to be reset when other PRAM settings such as the Startup Disk are changed e.g. if a new copy-over of the XPF Helper Files is triggered by changes to the /System/Library/Extensions/ folder then the boot device will be set back to the OS 9 partition until this is complete, this may also reset the PRAM patch. It should otherwise persist between reboots.

To confirm that the patch is in effect, only the monitor connected to the PCI graphics card should be visible in the Displays preference pane and the display resolution menu that can be displayed on the right-hand side of the Mac OS X menu bar. If the patch is not in effect, a non-existent second display labelled as "Multiple Scan Display" will also be visible. Do not use the Graphics section of the System Profiler utility as this has been found to trigger a kernel panic or freezing on unsupported (non-AGP) systems – all other parts of System Profiler are safe to access.



4. OPTIMISATION OF MAC OS X 10.5 LEOPARD AFTER INSTALLATION

This section applies to all Macs running Leopard but more so to those not officially supported as they are more likely to have lower system resources than later models.

The main optimisations available are those that allow a significant amount of hard disk space to be recovered. Each of the following points will recover some disk space and begin with those applicable to all Leopard installations, followed by those that are only relevant to particular configurations or not recommended for all users.

✓ **Remove all *designable.nib* files**

Mac OS X Leopard comes with a large number of *designable.nib* files within its application bundles, however these are unnecessary files left in by the compiler that would normally only be present in pre-release debug builds of software and not a final release. They do not serve any purpose and can be safely removed by running the following Terminal script (this should be done once all software and updates has been installed as further *designable.nib* files are likely to be created as updates are installed) in order to recover a significant amount of hard disk space:

```
sudo find / -type f -name designable.nib | awk -F '\t' '{print "\"" $1 "\""}' | xargs rm -v
```

These files are not present in earlier versions of OS X, nor in later versions. Mac OS X 10.6 Snow Leopard, the first version of OS X to ship without PowerPC support, was marketed as requiring significantly less disk space for installation than Leopard which led many to forgive Apple for dropping PowerPC support as they believed this reduction in size was due to the removal of PowerPC code, however in fact it appears to be due to changes such as no longer including large amounts of debug files that should not have been in Leopard to begin with. This is illustrated by the fact that a “Universal binary” will only actually shrink by around 10% if PowerPC code is removed, not 50% as widely believed, in addition to most of the binary files in Snow Leopard still being “Universal” despite the lack of PowerPC support overall (unfortunately enough of the core of the operating system is Intel-only to mean that it is not possible to run it unsupported on a PowerPC Mac though).

✓ **Remove the *Alex* speech voice**

The high-quality speech voice *Alex* occupies around 600 MB of disk space and can be safely removed if the Speech feature (or this particular voice) is not required by deleting the folder `/System/Library/Speech/Voices/Alex/`.

✓ **Remove foreign-language dictionaries and fonts**

Even if no foreign languages were selected during installation, a number of foreign-language dictionaries are still present in `/Library/Dictionaries/`. These can be safely removed if not required.

Likewise, fonts with non-English names can be removed from /Library/Fonts/ and /System/Library/Fonts if not required.

✓ **Remove Adobe Updater cache**

If Adobe Updater has been used to update installed Adobe products, a large and unnecessary update cache may have been created at /Applications/.AdobePatchFiles/ - this is a hidden folder so will need to be deleted using Terminal or by temporarily setting hidden files as visible (as described earlier in this guide).

✓ **Use *Monolingual* to remove processor architectures and languages from application bundles**

Important: only do this if critically short of drive space as there is the possibility of breaking applications, however there is the potential to save significant amounts of disk space if it is run after having installed all required applications and updates.

The free utility *Monolingual* can be used to remove non-required processor architectures (the architectures that an OS X application bundle can contain being PowerPC G3, PowerPC with Velocity Engine 32-bit (G4), PowerPC with Velocity Engine 64-bit (G5), Intel 32-bit, Intel 64-bit) and non-required languages from application bundle (.app) files. This will result in an OS X installation that will only run on Macs with the processor type(s) that were not removed.



Other steps that may be worth taking are:

✓ **Closing all Dashboard widgets when not in use**

Each Dashboard widget that is open occupies a portion of the available RAM right from when OS X is loaded, even if Dashboard is not being used. It is worth leaving all of the widgets closed and using the "+" button in the bottom left of the Dashboard screen to open them when they are required if limited RAM is available.

✓ **Disable Spotlight indexing**

Spotlight indexing will normally cause a noticeable slowdown in performance for a relatively short period after OS X is first installed and when adding a large amount of new files/software/updates.

However, all of the Mac's hard drive partitions can be added to the *Privacy* section of the Spotlight preference pane to disable indexing if it is found to cause a persistent performance issue or indexing (indexing by the magnifying glass icon in the top-right corner of the screen pulsating) does not stop.

✓ **Disk defragmentation**

Unlike Windows, Mac OS X is designed to perform disk defragmentation as and when files are accessed and found to be fragmented across the hard disk.

However, some users run third-party disk defragmentation tools such as *iDefrag* in an attempt to increase performance by ensuring that disk fragmentation is minimised. Disk defragmentation is most likely to be effective following the initial installation of the operating system and addition of large amounts of new files or software.



Thank you for using this guide